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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte EROL GIRT
and THOMAS P. NOLAN

Appeal 2008-3353
Application 10/776,222
Technology Center 1700

Decided: August 28, 2008

Before CATHERINE Q. TIMM, ROMULO H. DELMENDO, and MICHAEL P. COLAIANNI, *Administrative Patent Judges*.

COLAIANNI, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134 the final rejection of claims 1-5, and 11-20. We have jurisdiction over the appeal pursuant to 35 U.S.C. § 6(b).

We AFFIRM.

INTRODUCTION

Appellants' invention is directed to high recording density perpendicular magnetic recording media comprising improved *fcc* Au-containing interlayer structures for enhancing formation of main recording

layers having optimum crystallographic orientation (Spec. 1). The role of the interlayer is critical to obtain good media performance by controlling the crystallographic orientation of the main recording layer, controlling the grain size and grain distribution of the main recording layer, and physically separating adjacent grains of the main recording layer (Spec. 4).

Claim 1 is illustrative:

1. A perpendicular magnetic recording medium, comprising:

(a) a non-magnetic substrate having a surface; and

(b) a layer stack formed over said substrate surface, said layer stack comprising, in overlying sequence from said substrate surface:

(i) a magnetically soft underlayer;

(ii) a non-magnetic interlayer structure; and

(iii) a magnetically hard perpendicular main recording layer;

wherein said non-magnetic interlayer structure is selected from the group consisting of:

(1) a structure comprising a layer of a *fcc* Au-containing non-magnetic material having a <111> preferred growth orientation and a layer comprising Ru in overlying or underlying contact with said layer of *fcc* Au-containing non-magnetic material;

(2) a structure comprising, in overlying sequence, a layer of a *fcc* Au-containing non-magnetic material adjacent said magnetically soft underlayer and having a <111> preferred growth orientation, and *n* layers of a different *fcc* non-magnetic material having a <111> preferred growth orientation, where $n = 1 - 5$;

3 a structure comprising, in overlying sequence, a layer of a *fcc* Au-containing non-magnetic material adjacent said magnetically soft underlayer and having a <111> preferred growth orientation; *n* layers of a different *fcc*

non-magnetic material having a <111> preferred growth orientation, where $n = 1 - 5$; and n layers of a *hcp* non-magnetic material having a <0002> preferred growth orientation, where $n = 1 - 5$; and

4 an $(fcc)_1/(hcp)_1/(fcc)_2/(hcp)_2$ structure comprising, in overlying sequence, a first *fcc* layer $(fcc)_1$, a first *hcp* layer $(hcp)_1$, a second *fcc* layer $(fcc)_2$, and a second *hcp* layer $(hcp)_2$, wherein at least the first *fcc* layer is an Au-containing non-magnetic material.

The Examiner relies on the following prior art references as evidence of unpatentability:

Lambeth	WO 99/24973	May 20, 1999
Lal	5,922,442	Jul. 13, 1999
Abarra	US 2003/0186086 A1	Oct. 2, 2003
Nakamura	US 2004/0027868 A1	Feb. 12, 2004
Yamamoto	US 2004/0043258 A1	Mar. 4, 2004
Chen	US 2004/0191578 A1	Sep. 30, 2004

S. Malhotra et al., *Effect of CrRu Underlayer on the Magnetic, Recording, and Thermal Stability Characteristics of CoCrPtTa Thin Film Media*, IEEE Transactions On Magnetics 30, No. 5, 2309-2311(Sept. 2000).

The rejections as presented by the Examiner are as follows:

1. Claims 1, 13, 14, 17, 18, and 20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Lambeth in view Nakamura.
2. Claims 1-5, and 11-20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Abarra in view of Chen and/or Lal and/or Malhotra.
3. Claims 1-5, and 11-20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Abarra in view of Yamamoto, and further in view of Chen and/or Lal and/or Malhotra.
4. Claims 1-5, 11-13, 17, and 20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamamoto in view of Nakamura.

5. Claims 14-16, 18, and 19 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamamoto in view of Nakamura and Abarra.

Appellants separately argue claim 1 only.[1] Appellants' arguments regarding dependent claims 14-16, 18, and 19 of the fifth rejection merely restate Appellants' arguments made with respect to the rejection of claim 1 over Nakamura in view of Yamamoto (Br. 21-23). Accordingly, with regard to each of the rejections above, we address Appellants' arguments with regard to claim 1.

OPINION

35 U.S.C. § 103 REJECTION OVER LAMBETH IN VIEW OF NAKAMURA

Appellants argue that the Examiner has not established that Ti and Ru are functional equivalents in perpendicular magnetic recording medium having a non-magnetic interlayer structure, wherein the interlayer structure comprises a layer of a *fcc* Au-containing non-magnetic layer having a <111> preferred growth orientation and a layer comprising Ru in overlying or underlying contact with the layer of *fcc* Au-containing non-magnetic material as claimed (Br. 6). Appellants contend that neither Lambeth nor Nakamura discloses that the Ti and Ru are equivalents (Br. 6). Appellants further argue that there is no motivation in Lambeth and Nakamura to substitute an interlayer structure as claimed into the magnetic recording

[1] A species restriction was mailed on March 14, 2006, which required Appellants to elect one species from the Markush group of non-magnetic interlayer materials enumerated in claim 1. In the April 14, 2006 response, Appellants elected specie (1) of claim 1.

layer of Lambeth such that the Examiner has not carried the initial burden of establishing a prima facie case of obviousness (Br. 8 and 9). Appellants contend that the rejection is based on impermissible hindsight (Br. 10).

We have considered Appellants' arguments and are unpersuaded for the reasons below.

An improvement over the prior art would have been obvious if it is nothing more than the predictable use of prior art elements according to their established functions. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740 (2007). Where the prior art discloses that two features are equivalents, "[e]xpress suggestion to substitute one equivalent for another need not be present to render such substitution obvious." *In re Fouts*, 675 F.2d 297, 301 (CCPA 1982).

We agree with the Examiner's findings and conclusions presented in the Answer regarding Lambeth and Nakamura (Ans. 5-7). Accordingly, we adopt the Examiner's findings and conclusions as our own and add the following for emphasis.

Lambeth discloses a magnetic recording media (Lambeth 1). Lambeth discloses that the magnetic properties of a film are dependent on the microstructure of the film for a fixed composition and that for perpendicular magnetic recording media the desired crystalline structure of Co alloys is hexagonal close packed (*hcp*) (Lambeth 4). Lambeth discloses that the underlayer maybe an Au containing *fcc* material with a (111) crystal orientation (Lambeth 16, 17, 43-44). Lambeth further discloses that the Ti layer has a (0002) hexagonal close packed (hcp) structure (Lambeth 17, 44). Lambeth discloses that the (0002) crystal orientation is a nearly ideal perpendicular oriented recording layer (Lambeth 44). Lambeth discloses

that the magnetic material may be a Co-based material having a (0002) crystal texture (Lambeth 17).

Nakamura discloses a magnetic recording medium for perpendicular magnetic recording equipment (Nakamura, ¶ [0001]). Nakamura discloses the magnetic recording medium has a seed layer made of Au metal with a *fcc* (111) lattice structure, an underlayer of Ru or Ti, or alloys thereof with a hexagonal close packed (0002) crystal structure and a CoPt magnetic alloy (Nakamura, ¶¶ [0010], [0011], [0013], [0030]-[0034]). Nakamura further discloses that by providing a *fcc* (111) alignment of the seed layer leads to better alignment of the nonmagnetic layer (i.e., the Ru layer), which improves performance of the magnetic layer formed on the non-magnetic layer (Nakamura, ¶ [0038]).

These disclosures plainly indicate that Nakamura recognizes that Ti and Ru are functional equivalents. Specifically, Nakamura discloses that Ti and Ru form hexagonal close packed (0002) structures which aids in forming a magnetic layer with desirable crystal structure and properties (Nakamura, ¶ [0030]-[0034]). Moreover, Lambeth discloses that Ti forms a hexagonal close packed (0002) structure that significantly improves the ability of the Co-based magnetic layer to grow epitaxially in a (0002) orientation to produce a recording media having nearly ideal perpendicularly oriented magnetic recording layer (Lambeth 44). In other words, Nakamura and Lambeth both disclose that Ti forms a hexagonal close packed (0002) structure which functions to provide a suitable base for proper orientation of the magnetic layer. Nakamura further discloses that Ru is a substitute (i.e., functional equivalent) for Ti.

Accordingly, because the applied prior art recognizes Ru and Ti as functional equivalents, it would have been prima facie obvious to substitute Ru for Ti; express suggestion to substitute one equivalent for another need not be present to render such substitution obvious. *Fouts*, 675 F.2d at 301.

In light of the above findings and analysis, we determine that Appellants' argument that neither Lambeth nor Nakamura recognizes that Ti and Ru are functional equivalents is without persuasive merit.

Moreover, because we determine, as the Examiner had, that the art recognizes that Ti and Ru are functional equivalents, no motivation is necessary for the substitution of one equivalent for another equivalent. *Fouts*, 675 F.2d at 301. However, we determine that there is motivation for substituting Nakamura's Ru underlayer for Lambeth's Ti underlayer: to achieve the desired magnetic layer orientation for the perpendicular magnetic recording medium (Nakamura, ¶ [0033]). Accordingly, the Examiner's rejection is not based on impermissible hindsight as argued by Appellants.

We add that substituting Nakamura's Ru underlayer for Lambeth's Ti underlayer would have been obvious because such a substitution is nothing more than the predictable use of a prior art element (i.e., a Ru or Ti underlayer) for its established function (i.e., providing a layer with a desired crystal orientation for growth of the magnetic layer). *KSR*, 127 S. Ct. at 1740.

For the above reasons, we determine that the Examiner has established a prima facie case of obviousness, which has not been sufficiently rebutted by Appellants. We note that Appellants' have not

argued or provided evidence of secondary considerations (e.g., unexpected results).

For the above reasons, we sustain the Examiner's § 103 rejection of claims 1, 13, 14, 17, 18, and 20 over Lambeth in view of Nakamura.

35 U.S.C. § 103 REJECTION OVER ABARRA IN VIEW OF CHEN, LAL AND/OR MALHOTRA AND 35 U.S.C. § 103 REJECTION OVER ABARRA IN VIEW OF YAMAMOTO AND FURTHER IN VIEW OF CHEN, LAL AND/OR MALHOTRA

Appellants argue that the Examiner has not established that bcc CrRu and bcc Cr-M (e.g., CrTi) are known equivalents in perpendicular magnetic recording media having an interlayer as recited in claim 1 (Br. 10-11, 14). Appellants contend that because different elements and alloys have different lattice parameters and crystallographic structures and the affect the underlayer has on the overall magnetic recording medium is also dependent on the lattice parameters and crystallographic structure of the underlying and overlying layers, one of skill in the art would not have recognized that the Cr-M alloy of Abarra and the CrRu alloy of Chen, Lal, and Malhotra are known equivalents (Br. 11, 15). Appellants further argue that there is no motivation for the substitution of Chen's, Lal's, and Malhotra's CrRu alloy for the Cr-M alloy in Abarra or Abarra in view of Yamamoto (Br. 11-13, 15-17).[2] Appellants contend that the Examiner's rejections are based on impermissible hindsight (Br. 13, 17).

[2] While the Examiner determined that Abarra alone discloses the Au or Au-X material with sufficient specificity (Ans. 8 and 11) to render obvious the selection of Au, the Examiner cited Yamamoto as teaching the selection of an Au alloy with elements meeting Appellants' claimed limitations (Ans. 11). The Examiner concludes that it would have been obvious to modify

We have considered Appellants' arguments and are unpersuaded for the reasons below.

Abarra discloses a magnetic recording medium suited for high-density longitudinal magnetic recording (Abarra, ¶ [0004]). Abarra discloses that the underlayer includes a *fcc* crystalline structure or a *fct* (111) crystalline structure that is alloyed with Au (Abarra, ¶¶ [0071]-[0075]). An adhesive layer having a Cr-M composition and a *bcc* crystal structure is formed atop the *fcc* or *fct* crystalline structure layer wherein M maybe "B, Fe, Mn, Mo, Ti, V and W" (Abarra, ¶ [0079]). Abarra discloses that the adhesive layer is made of materials having the proper lattice parameters to promote epitaxy with the magnetic layer (Abarra, ¶ [0079]). Abarra's magnetic layer is made of a Co-based alloy having a hexagonal close packed (0002) structure, which is promoted by the (111) crystal structure of the underlayer (Abarra, ¶¶ [0081] and [0091]).

Chen discloses a magnetic recording media for ultrahigh density magnetic recording (Chen, ¶ [0001]). Chen discloses forming a magnetic layer and an underlayer wherein the underlayer comprises an chromium

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Abarra's magnetic media to include Yamamoto's Au containing *fcc* material since such a choice can result in improved lattice matching and improved chemical stability (Ans. 11). Appellants do not contest these determinations regarding Abarra alone or Abarra in view of Yamamoto, or the Examiner's obviousness conclusions regarding Abarra alone or the combination of Abarra in view of Yamamoto.

Appellants' only argument regarding the Au *fcc* material is that the Examiner has not established that CrRu is a functional equivalent with the Cr-M in an interlayer as claimed (i.e., having an Au-containing *fcc* layer). However, the Examiner has indicated in the rejections where Abarra or Yamamoto discloses the Au *fcc* feature, which the Appellants have not rebutted with any substantive argument or evidence.

alloy (i.e., CrTi or CrRu) having a (002) orientation (Chen, ¶¶ [0009] and [0010]). Chen discloses that the structure may contain a *fcc* intermediate layer containing Au in addition to the underlayer and magnetic layer (Abarra, ¶ [0011]). Chen discloses that it is desirable that "Ru, Mo, W, Ti, V, Zr, etc." be used as the alloying element A with Cr because it leads to a simultaneous lattice misfit, which forms a *fct* structure and lowers the ordering temperature of the magnetic material (Chen, ¶ [0032]).

Lal discloses a magnetic recording medium having an interlayer deposited between an underlayer and a magnetic recording layer (Lal, col. 1, ll. 11-13). Lal discloses that the underlayer strongly influences the crystallographic texture and microstructure of the magnetic recording layer (Lal, col. 1, ll. 43-45). Lal discloses using CrRu, CrV, CrSi, or CrGd alloy as the underlayer (Lal, col. 3, ll. 65-67; col. 4, ll. 1-7). Lal discloses using a CoCr alloy interlayer between the magnetic layer and the CrRu layer to improve lattice matching with the magnetic layer, thereby enhancing the magnetic recording properties (Lal, col. 2, ll. 29-34). Lal discloses that the magnetic material is a CoCr-based alloy (Lal, col. 4, l. 59).

Molhotra discloses that using a CrRu underlayer in a CoCrPtTa thin film media improves coercivity in the magnetic material due to the better in-plane orientation of the c-axis for the Co peak (Malhotra 2311). The CrRu underlayer was also found to give smaller physical and magnetic grain size resulting in lower noise for the magnetic media (Malhotra 2311).

Chen's, Lal's, and Malhotra's disclosures, taken as a whole, would have suggested that CrRu is a functional equivalent for Abarra's Cr-M materials. Specifically, Chen, Lal, and Malhotra all disclose that underlayers such as CrRu have an affect on the properties of the magnetic

layer formed thereon (Chen, ¶ [0032]; Lal, col. 1, ll. 43-45; Malhotra 2309, 2311). Similarly, Abarra discloses that the Cr-M material have lattice parameters to promote epitaxy with the magnetic layer (i.e., the Cr-M layer affects the magnetic layer structure) (Abarra, ¶ [0079]). Moreover, Chen's, Lal's, and Abarra's disclosures commonly indicate that CrV is an acceptable Cr alloy (Chen, ¶ [0032], Lal, col. 4, l. 1, and Abarra, ¶ [0079]).[3] Accordingly, the references disclose that CrRu is a functional equivalent for at least the CrV alloy disclosed in Lal, Chen, and Abarra.

We are unpersuaded by Appellants' argument that the different lattice structures and parameters of the underlayer affect the magnetic layer structure differently such that one of ordinary skill would not recognize Abarra's Cr-M disclosure as being a functional equivalent to CrRu. Appellants' argument misses the fact that Abarra, Chen and Lal commonly disclose using CrV. Moreover, Chen and Lal disclose that CrV and CrRu may be used interchangeably (i.e., as equivalents). Lal, Malhotra, and Abarra use similar Co-alloy magnetic material such that it is reasonable to expect that the CrRu underlayer would have successfully produced the required structure for the magnetic material.

Therefore, the disclosures of Chen, Lal, Malhotra, and Abarra taken as a whole teach that CrRu is a functional equivalent for at least the CrV alloy underlayer in Abarra. As such, it would have been prima facie obvious to substitute CrRu for another Cr alloy; express suggestion to substitute one equivalent for another need not be present to render such substitution obvious. *Fouts*, 675 F.2d at 301.

[3] We further note that Chen and Abarra commonly recite that acceptable Cr alloys include CrMo, CrW, and CrTi (Chen, ¶ [0032]; Abarra, ¶ [0079]). Chen adds that CrRu is also an acceptable Cr alloy (Chen, ¶ [0032]).

Regarding Appellants' motivation argument, as we determined above, CrRu is a functional equivalent for at least the CrV underlayer of Abarra, such that it would have been prima facie obvious to substitute the functional equivalents without an express suggestion. However, we further determine that Molhotra, Chen, and Lal provide motivation for the combination. Namely, Malhotra, Chen, and Lal disclose that using CrRu provides desirable properties for the magnetic material (Malhotra 2311; Lal, col. 7, ll. 10-62; Chen, ¶ [0032]). Accordingly, we find the Appellants' motivation and impermissible hindsight arguments are without persuasive merit.

For the above reasons, we sustain the Examiner's § 103 rejection of claims 1-5, and 11-20 under § 103 over Abarra in view of Chen, Lal, and Malhotra, and the § 103 rejection of claims 1-5 and 11-20 over Abarra in view of Yamamoto, Chen, Lal, and Malhotra.

35 U.S.C. § 103 REJECTION OVER YAMAMOTO IN VIEW OF NAKAMURA AND 35 U.S.C. § 103 REJECTION OVER YAMAMOTO IN VIEW OF NAKAMURA AND ABARRA

Appellants argue that there is no motivation to substitute Nakamura's CrRu underlayer for Yamamoto's CoCr intermediate layer (Br. 18-20). Appellants contend that the Examiner has not provided motivation from Yamamoto and Nakamura to substitute an interlayer having the claimed features of elected specie (1) into the magnetic recording media of Yamamoto (Br. 18). Appellants contend that the Examiner's rejections are based upon impermissible hindsight (Br. 20 and 23). We do not agree.

Yamamoto discloses a perpendicular magnetic recording medium suitable for ultra-high density magnetic recording (Yamamoto, ¶ [0001]). Yamamoto further discloses forming an Au-containing intermediate layer

having a face-centered cubic (*fcc*) structure and a Co-Cr hexagonal close packed (*hcp*) layer atop the Au-containing layer (Yamamoto, ¶¶ [0014], [0016], [0018], [0025], [0072], [0073]). Yamamoto discloses providing the Co-Cr non-magnetic intermediate layer having the same *hcp* structure as the magnetic layer to enhance the crystal orientation of the magnetic layer (Yamamoto, ¶ [0025]). Yamamoto discloses that the magnetic material may be Co-Cr-Pt alloy (Yamamoto, ¶¶ [0040], [0045]).

Nakamura discloses a perpendicular magnetic recording medium (Nakamura, ¶ [0001]). Nakamura further discloses a seed layer having a *fcc* (111) structure made of Au or an Au-containing alloy and a non-magnetic underlayer having a *hcp* structure made of Ru or an alloy thereof (Nakamura, ¶¶ [0032], [0033]). Nakamura discloses that using the *hcp* underlayer permits the magnetic grains to grow with the same *hcp* structure thereby providing an excellent perpendicular magnetic recording medium (Nakamura, ¶ [0033]). Nakamura further discloses that the combination of the *fcc* seed layer containing Au and the Ru containing underlayer provide lattice matching between the nonmagnetic underlayer and the granular magnetic layer thereby producing a superior perpendicular magnetic recording medium (Nakamura, ¶ [0034]). Nakamura discloses the magnetic material is a CoPt-alloy (Nakamura ¶ [0030]).

The Examiner found that the applied prior art provides motivation for substituting Nakamura's *hcp* Ru layer for Yamamoto's *hcp* CoCr layer since such a layer can improve the lattice matching between the seed layer and the magnetic layer and, hence, improve the perpendicular magnetic properties (Ans. 14). We agree.

Both Yamamoto's and Nakamura's above disclosures teach the importance of having an intermediate layer having an *hcp* structure overlying a *fcc* (111) Au-containing layer to provide a magnetic layer with desirable crystal structure and thus magnetic properties. Yamamoto discloses a *hcp* CoCr layer over a *fcc* (111) Au containing layer, whereas Nakamura discloses a *hcp* Ru layer over a *fcc* (111) Au-containing layer. Nakamura further discloses that the *hcp* Ru layer provides an excellent perpendicular magnetic material due to the lattice matching between the *fcc* Au-containing seed layer and the *hcp* Ru layer. Thus, not only does the art teach the argued claim feature, but motivation is provided by the art for the combination.

Accordingly, we agree with Examiner that Nakamura provides motivation for substituting the *hcp* Ru layer for Yamamoto's *hcp* CoCr layer in the magnetic medium in order to produce an excellent perpendicular magnetic medium. We add that Nakamura's and Yamamoto's magnetic medium use a Co-alloy as the magnetic material. Accordingly, there is a reasonable expectation that substituting Nakamura's *hcp* Ru layer for Yamamoto's *hcp* CoCr layer would have successfully produced an excellent perpendicular magnetic medium with a Co-alloy magnetic layer. Therefore, the Examiner's rejections are based on the teachings of the references and not impermissible hindsight.

For the above reasons, we sustain the Examiner's § 103 rejection of claims 1-5, 11-13, 17, and 20 over Yamamoto in view of Nakamura, and the § 103 rejection of claims 14-16, 18, and 19 over Yamamoto in view of Nakamura and Abarra.

DECISION

The Examiner's decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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